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Italy

On Green Concrete

Associate Professor Dr. Julia Nerantzia Tzortzi

PhD Candidate Arch. Rola Hasbini

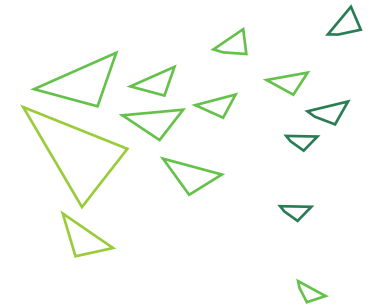
Advanced Construction Materials and Innovative Buildings Technologies

Department of Architecture, Built Environment & Construction Engineering

About Us

Dr. Julia Nerantzia Tzortzi

Short Biography

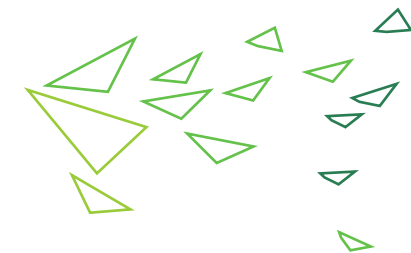


Dr. Julia Nerantzia Tzortzi

- She is associate professor at the Department of Associate Professor Department of Architecture, Built Environment and Construction Engineering of Politecnico di Milano.
- She has established the Master of Landscape Architecture (MLA) at Neapolis University as Coordinator of the Master and as Head of the Department of Architecture, Land and Environmental Sciences of Neapolis University of Pafos.
- Julia is Vice President of the Greek Association of Landscape Architects-PHALA, Board Member of LE:NOTRE INSTITUTE, Member of Landscape Institute (UK), member of IFLA, where she is active in the IFLA WGs: “UIA / IFLA Working Group Indigenous Ecosystem Corridors and Nodes” and “Cultural Landscapes”.
- Julia has served for 15 years as Executive Professional in Landscape Architecture at the Ministry of Environment, Urban Planning and Energy – Climate Change of Greece. During her service at the Ministry she served as General Project Manager at the Environmental Awareness Park Organization of Antonis Tritsis, the largest urban park in Greece (120 Ha).

About Us

Dr. Julia Nerantzia Tzortzi



- During the years 2000-2004 Julia offered her expertise as General Project Manager and Head of Environmental Department for the Athens 2004 Olympic Games. She designed and supervised the construction of significant landscape projects (urban, periurban parks, greenways, venues) of ATHENS 2004 Olympic Games such as the Contemporary Marathon Route and the surrounding environment of Olympic Venue (e.g. Whistle House, the landscape design of the surrounding area of Peace and Friendship Stadium, the renovation of Athens National Garden, the redesign of Pedion Areos Park, the landscape preservation of the Historic Garden of Zappeion Megaron, the landscape design for Exarchia square, and the landscape design of Kolonaki square).
- From 1997 to 2000 she was Head of the Environmental Department of EGNATIA ODOS S.A. Design/Construction Company which specifically designed and constructed Egnatia Odos, the transnational Road from Adriatic Sea throughout Greece up to the borders with Turkey.
- The last 10 years she has been leading more than 30 European Programmes (e.g. HOMEE, proGReg, GREENLINK, PERIURBAN, GARDEN ART DESIGN) with an emphasis on Cultural Landscapes, Environmental Design and Climate Change (HORIZON 2020, INTERREG IVC, FP7, LIFE+).

Short Biography

Arch. Rola Adnan Hasbini



- She is an Architect currently a PhD Candidate with the subject Advanced Construction Materials & Innovative Building Technologies at the Department of Architecture, Built Environment & Construction Engineering at Politecnico di Milano.
- She graduated from the Faculty of Engineering & Architecture (Department of Architecture) at the American University of Beirut, LB where she received distinctive rewards with records on the Dean's Honor List (Architecture).
- She completed the Executive Masters of Business Administration (Olayan School of Business) at the American University of Beirut, LB (2012-2014).
- She is member of AUBotanic Society.
- She was Instructor at the Department of Architecture - the American University of Beirut, LB (1994 – 1995).
- She is, currently, the Owner of the firm Architecture, Design & Development - ADD sarl.
- She is partner at “Adnan Hassan Hasbini Co. since 1966” agricultural and landscaping firm.

About Us

Arch. Rola Hasbini

Key Facts

Air pollution is dangerously high (WHO)

- 9 out of 10 persons in the globe breathe high levels of pollutants.
- 7 million premature deaths.

Cause of many human diseases (WGBC)

- 1/3 of global deaths from heart diseases.
- Cause of many other diseases such as asthma.

Carbon Dioxide is the most significant GHG

- 40% of CO₂ are emitted from buildings life cycle.
- Approx. 3 billion tonnes of CO₂ emissions/year from cement industry.
- Cement industry emits 6% to 8% of global CO₂.



Figure 1. View of Beirut from Fayyadiyah mountain hill. (16/9/2020) .
The capital is in the background quasi totally covered by pollution fog.

The Silent Killer

What is Concrete?

Composition

- Concrete is a construction material composed of cement (most commonly Portland cement), fine aggregates (sand) and coarse aggregates mixed with water.
- Portland cement is composed of 80% burning limestone and 20% clay.

Cement Manufacture

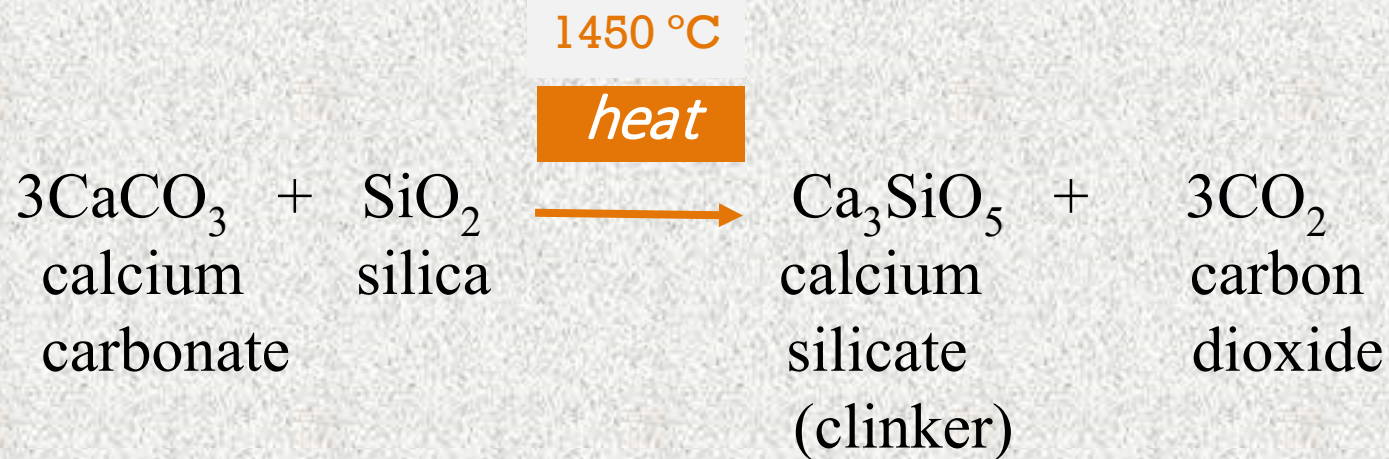
- Cement clinker is manufactured in a rotary kiln at a temperature of 1450 °C approximate.

CO₂ Emissions

- 50% of CO₂ are emitted directly from the de-carbonation of limestone or calcination process.
- 40% of CO₂ are emitted from fuel combustion in the rotary kiln.
- 10% of CO₂ are indirect emissions from quarrying and transportation.

Chemical Reaction of Cement

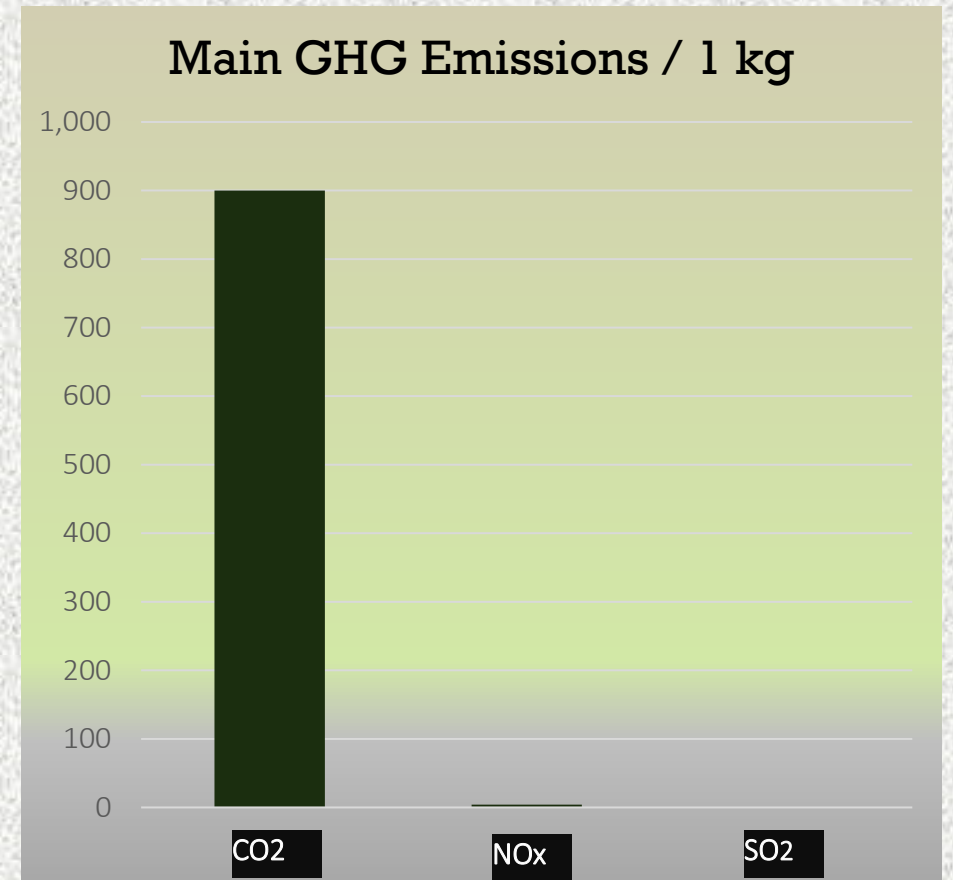
Cement clinker is the product of calcination i.e. when calcium carbonate (CaCO_3) and silicon dioxide (SiO_2) are combined in furnace at $1450\text{ }^\circ\text{C}$ to form tricalcium silicate or clinker.



Cement Main GHG Emissions at Production

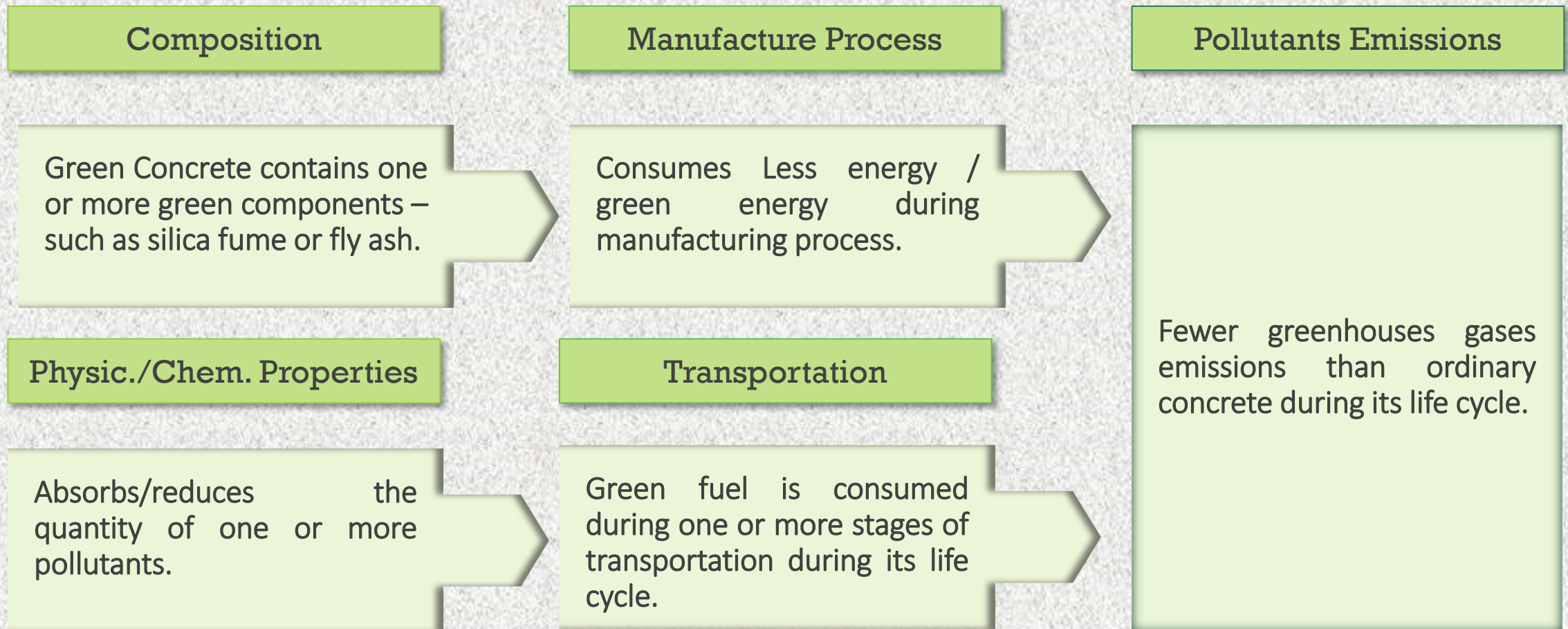
Estimate in g.

GHG Emissions per 1,000 g of production	CO2	NOX	SO2
Estimate Amount	900	4	0.27



What is Green Concrete?

It is an ecological building material with a positive impact on the environment in one or all of the stages of its life cycle



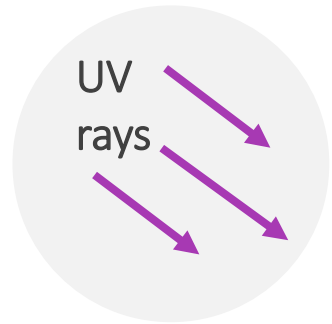
The Photocatalysis Reaction

A leading Italian firm has developed a green cement with titanium dioxide component.



Composition

The cementitious material contains titanium dioxide TiO_2 .



NOx abatement

Light generates a series of chemical reactions turning NO_x into NO_3^- :

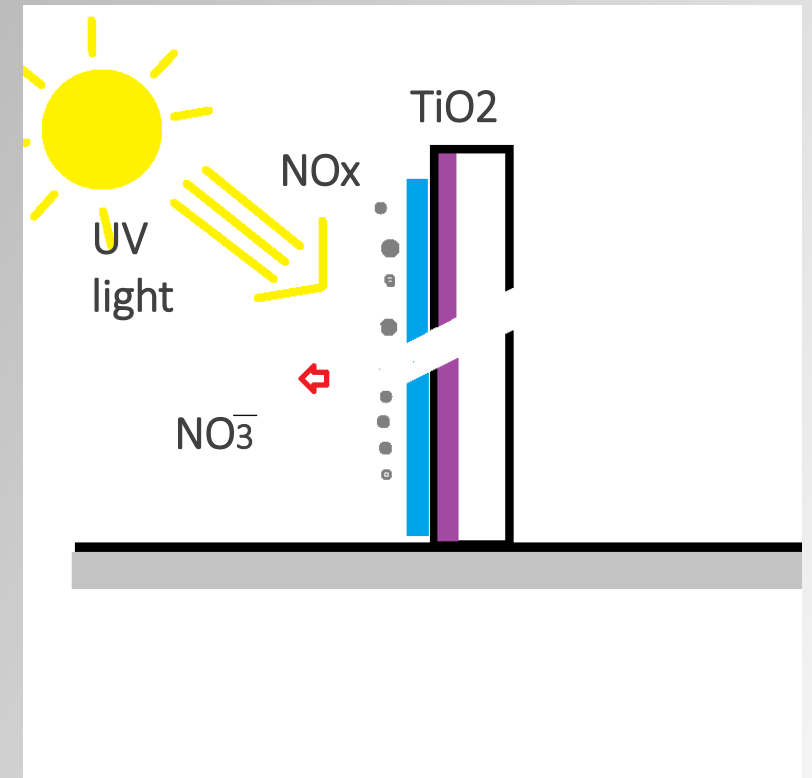


Anti-contamination

NO_3^- and contamination are washed out by water such as rain



Used as finish building or urban component – precast panels or pavement blocks or others, it, also, help to reduce heat islands effects.



Results

Many alternatives present several barriers:



Availability / Environmental Considerations

The alternative should not deplete an environmental resource.



Performance / LCA

The alternative should outperform the ordinary concrete during its life cycle.



Cost

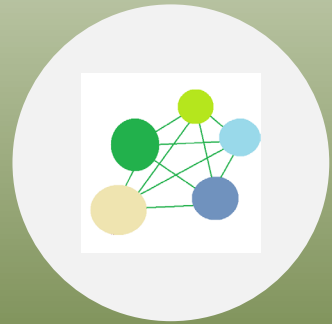
The alternative should present optimized life cycle cost.

Recommendations for an Efficient Green Concrete Alternative



Standards definition

- Global platform
- database



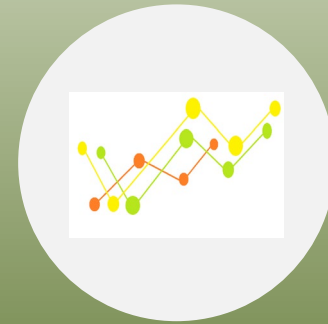
Cross-disciplinary collaboration

- Engineering
- Environmental
- Agriculture
- Others



Further Research / Innovation

- Production
- Composition
- Phys./Chem. Reactions
- Others



Models

- Analytical
- numerical
- experimental



Demonstration projects

- Performance tests
- Field data

Conclusion

Further research is required

- Circular economy / life cycle assessment is required for the green concrete alternative.
- The low carbon footprint concrete alternative specifications should outperform the ordinary worldwide used concrete material positive specifications including high performance, wide availability and cost.
- A global platform/database should be developed for further analysis.
- All parameters impacting the raw materials and the overall green concrete performance to be determined.
- Finally, built large structures with this proposed green alternative(s) should present a proof of the withstanding of the various structural conditions and, above all, the test of time.

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Thank You



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